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Secret
Copy No.

TRIM SYSTEM

Description and Maintenance
Instructions

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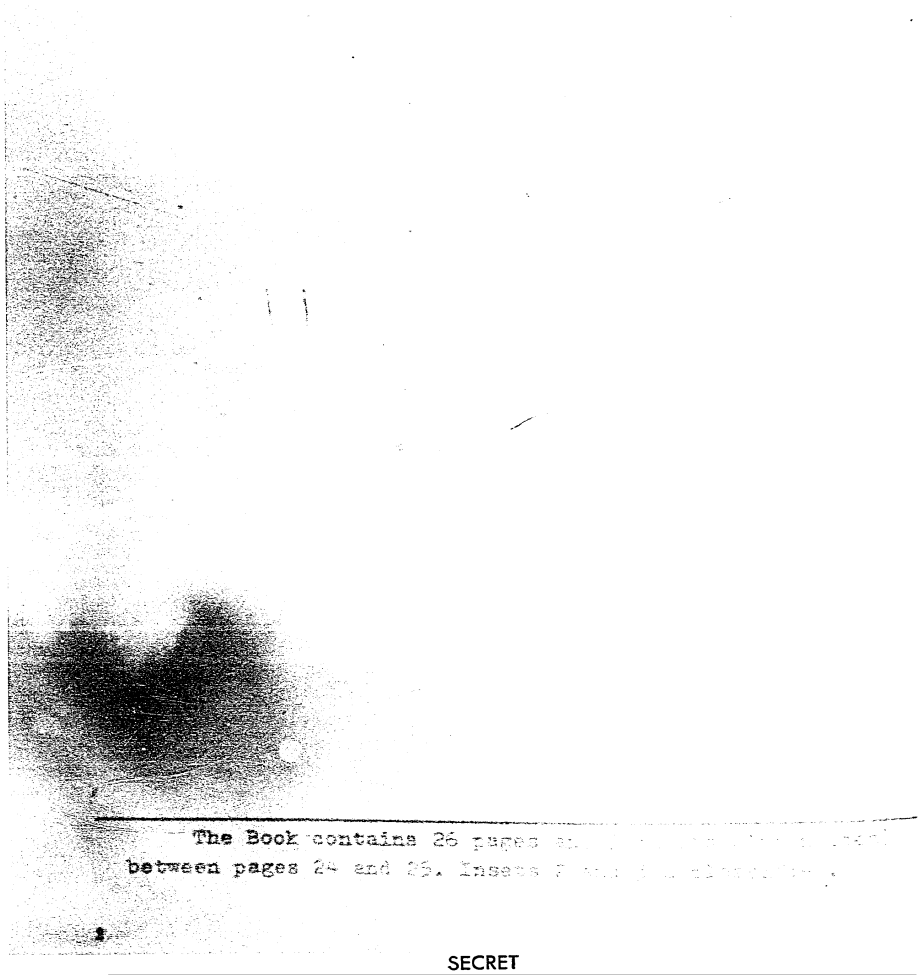

The Book contains 26 pages
between pages 24 and 25. Inserts

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C O N T E N T S

I. [illegible]

A. PURPOSE AND BASIC CHARACTERISTICS

The function of the trim system is to control the fore-and-aft balance, i.e. to remove the trimming moments which occur due to consumption of variable weights in the course of cruising.

Thus the trim system, together with the water system and the intermediate pressure air system, is used for:

(1) flooding the trim tanks with sea water either by gravity or with the aid of the bilge pump;

(2) draining the trim tanks outboard with the aid of the bilge pump or with intermediate pressure air;

(3) transferring water from the fore trim tanks to the aft trim tanks and vice versa with intermediate pressure air.

The pipe line consists of [illegible] and steel pipes, [illegible].

[illegible]

Description	Net volume, m³	Location			Remarks
		compartment	side	frames	
Fore trim tank No.2	4.22	Compart. I, outside the pressure hull	Port	10–14	
Aft trim tank No.3	4.16	Compart-ment VII	Starboard	116–124	
Aft trim tank No.4	4.16	Compart-ment VII	Port	116–124	

To measure the amount of water in the tanks, each tank mounts sounding rods 31, 32, 33 and 34.

Measurement of the amount of water in the tanks may be done irrespective of pressure in the tanks.

To protect the tanks from excessive pressure, aft trim tanks Nos 3 and 4 are equipped with safety valves 17 and 18; safety valves 15 and 16 are mounted on the pipe line before fore trim tanks Nos 1 and 2.

These valves are adjusted for a pressure of 4.7 kgf/sq.cm and sealed.

(a) Water Trim Line

This consists of two lines.

One of the lines is used to connect the trim tanks arranged on the port side (fore tank No.2 and aft tank No.4), while the other is used to connect the tanks arranged on the starboard side (fore tank No.1 and aft tank No.3).

Sited in compartment III are angle shut-off valves [illegible] and 22.

For flooding and draining the [illegible] is connected with the shipboard drain [illegible] valve manifold 12.

Mounted on the pipe running from [illegible] tank No.2 is water flow meter [illegible], valve 21 to aft trim tank [illegible].

Before and after the water flowmeters there are strainers to protect the flowmeters from clogging.

The pipes [illegible] mount valves 1, 2, 3 and 4 which are used to disconnect the tanks in an emergency. These valves are [illegible] in the open position. Inside the tanks the pipes are lowered to the bottom.

(b) Air Trim Line

This consists of two lines connecting the fore and aft tanks of both sides. The working pressure of air in the pipe line is equal to [illegible] kg/sq.cm.

Air supply to the trim pipe line is effected from compartment [illegible] from the intermediate pressure air system [illegible] and pressure-reducing valves 10 and [illegible] and 20.

[illegible] equipped with safety val-[illegible].

[illegible] direct the air to [illegible] - to the port [illegible]

[illegible] for [illegible]

[illegible]

(a) Air [illegible]

Control valve 19 is used to feed air to the tanks and to vent them.

Body 38 of the control valve is made of brass and it has four pipe unions and two sockets.

Two pipe unions are used to supply air to the tanks, the other two being used to vent the tanks into the compartment and to receive the pressure gauge. Screwed into the sockets are the pressure-reducing and safety valves. The safety valve is adjusted for a pressure of 4.7 kgf/sq.cm.

Taper bronze plug 39 with two channels is lapped in body 38.

The stem of the plug where it extends from body 38 is sealed with packing 40.

The plug is turned with the aid of wrench 35.

Control valve 20 is identical to control valve 19 in the construction.

(b) Silencer (see Fig. 2)

This is meant for damping the noise due to escaping of the compressed air.

Body [illegible] is of [illegible] construction.

Arranged inside [illegible] sleeve [illegible].

[illegible] between sleeve [illegible] and the wall of body [illegible] is [illegible]

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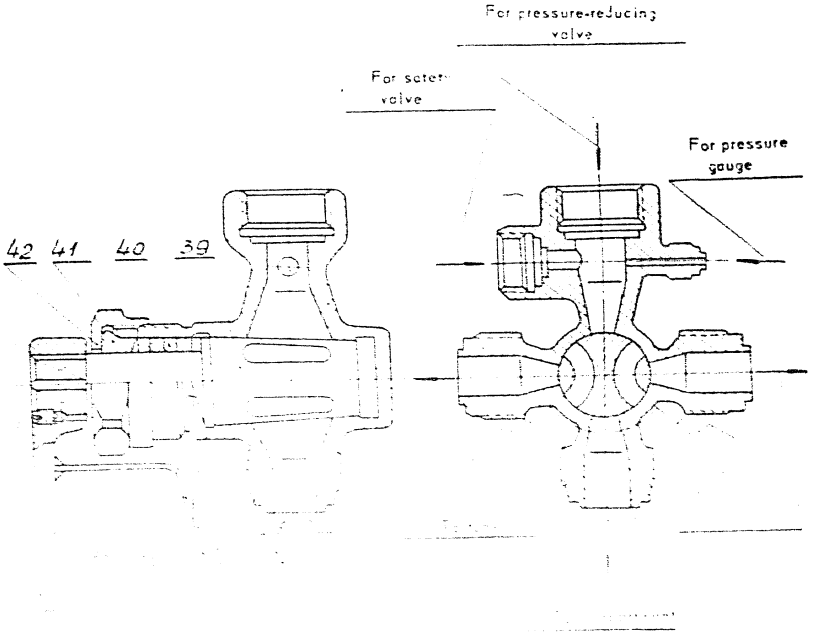

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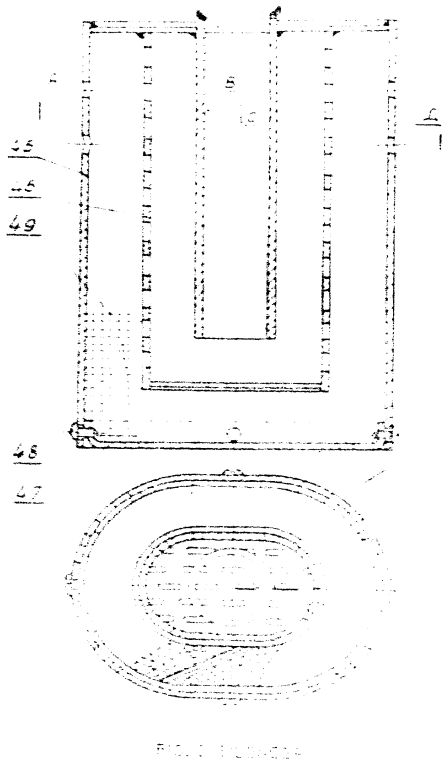

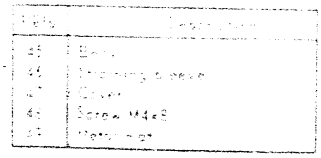

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other division to indicate the amount of water in the tanks, in litres. Sounding rod plug 52 has openings to bleed the air.

The flanged joint of the split casing of the sounding rod is packed with paronite gasket 66.

The shut-off valves are made of bronze; valve plates 56 are packed with rubber gaskets 57. Valve stems 60 are packed with rubber rings 61. The valves are opened through the linkage running from pedal 65. Springs 59 are provided to return the valve plates and the pedal to the initial position.

The linkage of the sounding rod consists of one or two (for the sounding rods in the split casing) tappets 63 and coupling 62. To ensure independent opening of the upper and lower valves, the parts of the linkage are assembled with a clearance.

The total length of the linkage is adjusted with coupling 62. The amount of water in the tanks is determined as follows: by pressing pedal 65 the upper and lower valves get opened thus simultaneously communicating the upper and lower portions of the tanks with the interior of sounding rod casing 53. In 20 - 30 seconds release the pedal and start slowly turning plug 52. After the pressure has completely relieved through the bored openings in the plug, turn out the plug and remove the sounding rod.

[illegible]

[illegible] control instruments: [illegible] [illegible]

[illegible]

[illegible] compartment III [illegible] the amount [illegible] trim tanks. The maximum [illegible] flowmeter is 110 m^3/hr [illegible] 55 m^3/hr for a protracted period of operation. [illegible] flow measured by the water flowmeter is [illegible] m^3/hr. The maximum temperature of water running through the water flowmeter is 50°C.

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[redacted]

1. [redacted]

The pressure [redacted] are installed on the air pipe line in compartment III and are used to check the pressure in the trim tanks which shall be within 3 to 4.5 kgf/sq.cm when [redacted] transferring water.

The limit value measured by the pressure gauge is 10 kgf/sq.cm, the red line is against 4.5 kgf/sq.cm.

3. Sounding Rods

These are used to indicate the amount of water in the trim tanks irrespective of presence of air in them.

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[redacted]

II. [illegible]

For trimming the submarine [illegible] with the instructions for [illegible] compensation of variable weights.

A. GENERAL SUPERVISION AND UPKEEP

With the trim system in operation:

1. See to it that the pipe lines and fittings are perfectly tight.

2. See to it that all the valves are easy to get at.

3. Keep the nameplates in good order.

4. Check to see that the pressure gauges and safety valves are sealed.

Upon expiration of the guaranteed period of the control instruments or in case they produce wrong readings, they shall be sent for checking or replaced with new ones.

5. Check the pipes for corrosion, cracks and honeycombs.

6. Keep the strainer meshes in good order. Not less than once a year and before a protracted cruising clean them.

7. Every time after disassembly and once a year irrespective of disassembly check the water and air pipe lines for tightness under a hydraulic pressure of 4.5 kgf/sq.cm.

B. PREPARATORY STEPS (See Appendix 1)

1. Initial Position

8. The tanks are drained and pressure relieved.

9. Valves 1, 2, 3, 4, 5, 6, 7 and 8 are sealed in the OPEN position.

10. Control valves 19 and 20 are shut.

11. Valve 9 before cruising shall be open and shall be left open during cruising only.

12. The rest of the valves are shut and are to be opened for fulfilment of separate manipulations, after which they shall be shut again. The sounding rods are screwed and packed.

2. Taking Water into Trim Tanks

When running on the surface, sea water flows by gravity into fore trim tanks No.2 and aft trim tank No.3 through water flowmeters 24 and 23.

In case of necessity the tanks may be flooded with the aid of the bilge pump.

Prior to taking water into the tanks, prepare the drainage system proceeding in accordance with the Drainage System Operating Instructions.

Water may be taken into each tank separately or simultaneously into both the tanks.

For independent filling of trim tank No.2 with water, proceed as follows:

13. Open the valve of the two-valve manifold 12 bearing the inscription PORT TRIM TANKS (ДИФФЕРЕНТНЫЕ ЦИСТЕРНЫ ЛЕВОГО БОРТА).

14. Set the indicator of control valve 20 to the VENTING OF BOW, AIR TO STERN position (ВЕНТИЛЯЦИЯ НОС - ВОЗДУХ КОРМА).

15. Watching water flowmeter 24 take the required amount of water proceeding in strict adherence with operating instructions for the shipboard drainage system.

For independent filling of trim tank No.3 with water, proceed as follows:

16. Unseal and shut valve 1.

17. Open the valve of the two-valve manifold 12 bearing the inscription STARBOARD TRIM TANKS (ДИФФЕРЕНТНЫЕ ЦИСТЕРНЫ ПРАВОГО БОРТА).

18. Open valve 21.

19. Set the indicator of control valve 19 to the VENTING OF STERN, AIR TO BOW position (ВЕНТИЛЯЦИЯ КОРМА - ВОЗДУХ НОС).

20. Watching water flowmeter 23, take the required amount of water proceeding in accordance with the operating instructions for the shipboard drainage system.

When filling trim tanks Nos 2 and 3 simultaneously, do the following:

21. Unseal and shut valve 1.

21. Open the valves of two-valve manifold 12.

22. Open valve 21.

23. Set the indicator of control valve 20 to the VENTING OF BOW, AIR TO STERN position: set the indicator of control valve 19 to the VENTING OF STERN, AIR TO BOW position.

24. Watching water flowmeters 23 and 24 take the required amount of water proceeding in accordance with the operating instructions for the shipboard drainage system.

25. After reception of water into trim tank No.3 or into trim tanks Nos 2 and 3, open and seal in this position valve 1.

26. After reception of water into the trim tanks (Item "b", Section "B"), stop feeding water into the tanks proceeding in accordance with the operating instructions for the shipboard drainage system.

N o t e s: 1. Futheron water taken into tanks Nos 2 and 3 shall be distributed in accordance with the instructions for the variable weights consumption and compensation.

2. Sea water may be also taken into tanks Nos 1 and 4; in this case the amount of water is checked by the sounding rods only.

3. <u>Pressurizing the Trim Tanks with Intermediate Pressure Air</u>

For pressurizing the tanks with air, feed the compressed air into the tanks filled with water to create a pressure of 4.5 kgf/sq.cm inside them.

Prior to feeding the air into the tanks prepare the intermediate pressure air system, proceeding in accordance with the operating instructions for this system.

Feed the air to tanks in pairs: to Nos 2 and 3 or Nos 1 and 4.

<u>When feeding the air into tanks Nos 2 and 3</u>, proceed as follows:

27. Set the [illegible] of control valve 20 to the AIR TO BOW - VENTING OF STERN [illegible] position.

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NORMA) and the indicator of control valve 19 to the AIR TO STERN, VENTING OF BOW position (in the NORMA - [illegible] No.3).

28. Slowly open pressure-reducing valves 10 and 11 watching pressure gauges 27 and 28 to see the pressure rising.

When feeding the air into tanks Nos 1 and 2, do the following:

29. Set the indicator of control valve 20 to the AIR TO STERN, VENTING OF BOW position and the indicator of control valve 19 to the AIR TO BOW, VENTING OF STERN position.

30. Slowly crack pressure-reducing valves 10 and 11 watching pressure rising by pressure gauges 27 and 28.

CAUTIONS! 1. See to it that the pointers of pressure gauges 27 and 28 should not overshoot the red line (4.5 kgf/sq.cm).

2. DO NOT USE the aft tank for trimming the submarine when water from it is taken for cooling the motor-driven compressor.

3. If pressure in trim tank No.3 or in trim tank No.4 was reduced to 2 kgf/sq.cm, to cool the motor-driven compressor with water from the tank, pressurize the tank to a pressure of 4.5 kgf/cm after disconnecting of the motor-driven compressor.

C. STARTING, DURING-OPERATION MAINTENANCE AND STOPPING

1. Water Transferring

The preset trim is maintained by transferring water from the fore trim tanks to the aft ones or vice versa.

When transferring water from the fore tanks to the aft ones, proceed as follows:

31. Set the indicators of respective control valves 19 or 20 to the AIR TO BOW - VENTING OF STERN position.

32. Open valves 21 or 22.

When transferring water from the aft tanks to the fore ones, proceed as follows:

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33. Set the indicators of respective control valves 19 or 20 to the AIR TO STERN - VENTING OF BOW position.

34. Open by-pass valves 21 or 22.

N o t e s: 1. Check the amount of water transferred by water flowmeters 23 and 24.

2. Watch pressure gauges 27 and 28 to check pressure drop in the tank from which water is transferred and feed air to this tank as necessary.

2. Draining the Tanks with Pump

The tanks are drained with the help of the bilge pump.

Prior to draining the tanks, prepare the water pipe line system proceeding in accordance with the operating instructions for the shipboard drainage system.

When draining No.1 tank:

35. Open the valve of two-valve manifold 12 bearing the inscription STARBOARD TRIM TANKS.

36. Set the indicator of control valve 19 to the VENTING OF BOW - AIR TO STERN position.

37. Pump out water proceeding in strict adherence with the operating instructions for the shipboard drainage system.

When draining No.2 tank:

38. Open the valve of two-valve manifold 12 bearing the inscription PORT TRIM TANKS.

39. Set the indicator of control valve 20 to the VENTING OF BOW - AIR TO STERN position.

40. Pump out water proceeding in strict adherence with the operating instructions for the shipboard drainage system.

When draining No.3 tank:

41. Unbend and shut valve 1.

42. Open the valve of two-valve manifold [illegible] bearing the inscription STARBOARD TRIM TANKS.

43. Open valve 21.

44. Set the indicator of control [illegible] to the AIR TO STERN - VENTING OF BOW position.

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45. Pump out water proceeding in strict adherence with the operating instructions for the shipboard drainage system.

When draining No.4 tank:

46. Unseal and shut valve 2.

47. Open the valve of two-valve manifold 12 bearing the inscription PORT TRIM TANKS.

48. Open valve 22.

49. Set the indicator of control valve 20 to the VENTING OF STERN - AIR TO BOW position.

50. Pump out water proceeding in strict adherence with the operating instructions for the shipboard drainage system.

On completion of draining, bring the system to the initial position.

3. Draining the Tanks with Intermediate Pressure Air

The trim tanks may be blown with compressed air in an emergency at a depth not below 40 m.

Prior to draining the tanks, prepare the shipboard drainage system and the intermediate pressure air system.

To drain the tanks with intermediate pressure air, bring the fittings on the water pipe line of the tank to be drained to a position in accordance with the directions outlined under Item "b" of the Section "C", after which:

51. To drain tanks Nos 1 and 2, set the indicators of control valves 19 and 20 to the AIR TO BOW - VENTING OF STERN position.

52. To drain tanks Nos 3 and 4, set the indicators of control valves 19 and 20 to the VENTING OF BOW - AIR TO STERN position.

53. Slowly crack pressure-reducing valve 10 or 11 depending on the tank to be drained and watch pressure gauges 27 and 28 to check the pressure lest the pointers of the pressure gauges should overshoot the red line against the division of 4.5 kgf/sq.cm.

54. On completion of blowing, bring all the fittings except for the control valves to the initial position. Control

valves 19 and 20 after the pressure has been relieved from the tank shall be set to a position to ensure that all of the tank blown.

D. TROUBLES AND REMEDIES

No.	Symptom or difficulty	Condition may be due to	Correction
1	Gland packings of valves and cocks leaky	Nuts tightening gland bushes loose. Gland packing worn	Tighten up nuts of glands. Replace gland packing
2	Valves leaky	Uneven wear or damage of fitting surface of plates or saddles	Lap valve plates
3	Air leaks through cocks	Plugs untightly fitted in body	Tighten up glands
		Uneven wear or damage to lapped surface of plugs or bodies	Lap cock plugs
4	Sounding rods produce wrong readings	Packing rings or gasket worn; spring defective	Replace packing rings, gaskets or spring
5	Pipe joints untight flanged joints	Nuts loose. Thread of bolts or nuts damaged	Tighten up nuts. Replace bolts or nuts
		Gasket torn	Replace gasket
6	Union joints	Nuts loose. Gasket torn	Tighten up nuts. Replace gasket
7	No water flows	Straining meshes clogged	Clean strainers

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E. PREVENTIVE INSPECTION AND REPAIR

1. Daily Inspection

55. Inspect the pipe lines, fittings and the control instruments to make sure that they are in good order and perfectly tight and all the friction surfaces of the fittings are properly lubricated.

56. Make sure that the seals are present on the pressure gauges and safety valves.

57. Work out all the fittings except for those which are sealed.

2. Weekly Inspection

Perform the procedures of daily inspection and in addition do the following:

58. Coat all the friction parts of the fittings with a lubricant, work out sticky valves.

3. Monthly Inspection

Perform the procedures of weekly inspection and in addition do the following:

59. Turn and work out the sealed fittings after which seal them again.

60. Check to see that the water flowmeters produce correct readings and the air control valves are perfectly tight.

4. Inspection Every Three Months

Perform the procedures of the monthly inspection and in addition do the following:

61. Pop the safety valves.

62. Inspect the parts of the special sounding rods.

63. Disassemble, clean and wash the parts of the inner chambers of the water flowmeters.

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5. Inspection during Docking the Ship

64. Replace the [illegible] assembly under the working pressure.

65. Clean, paint and test for tightness the trim tanks.

6. Inspection during Routine Repair

66. Perform the procedures of the inspection carried out every three months and in addition do the following:

67. Disassemble, inspect and repair, if necessary, the control valves.

68. Disassemble, inspect, repair and adjust the air and water safety valves.

69. Check the assembled water and air pipe lines for tightness under hydraulic and air pressure, respectively.

7. Checking the Pipe Lines for Tightness

To check the pipe lines of the trim system for tightness, proceed as follows:

70. Bring the system to the initial position.

71. Prepare the pipe line to be tested proceeding in accordance with Table 2.

72. Fill the section of the pipe line to be checked with water.

73. Check the air pipe line for tightness with intermediate pressure air fed to the section to be [illegible] from the intermediate pressure system through valve [illegible].

74. Screw the pipe union of the supply line running from the hydraulic [illegible] indicated in the Table.

75. Create a required pressure in the [illegible] checked and watch the pressure gauge.

76. Check the [illegible] and the joints of the [illegible] under check for [illegible] as follows:

(a) air [illegible] by coating them with soapsuds;

(b) water [illegible] joints for leakage for 15 minutes by watching the [illegible].

5. Inspection [illegible] the Ship

64. Replace the [illegible] under the working pressure.

65. Clean, paint and test for tightness the trim tanks.

6. Inspection during Routine Repair

66. Perform the procedures of the inspection carried out every three months and in addition do the following:

67. Disassemble, inspect and repair, if necessary, the control valves.

68. Disassemble, inspect, repair and adjust the air and water safety valves.

69. Check the assembled water and air pipe lines for tightness under hydraulic and air pressure, respectively.

7. Checking the Pipe Lines for Tightness

To check the pipe lines of the trim system for tightness, proceed as follows:

70. Bring the system to the initial position.

71. Prepare the pipe line to be tested proceeding in accordance with Table 2.

72. Fill the section of the pipe line to be checked with water.

73. Check the air pipe line for tightness with intermediate pressure air fed to the section to be checked from the intermediate pressure system through valve 9.

74. Screw the pipe union of the supply pipe line running from the hydraulic ram as indicated in the Table.

75. Create a required pressure in the section to be checked and watch the pressure gauge.

76. Check the fittings and the joints of the section under check for tightness as follows:

(a) air fittings and joints by coating them with soapsuds;

(b) water fittings and joints for leakage for 15 minutes by watching the pressure gauge.

77. Test the sections of the pipes from the weld-ons on the tanks as far as the respective valves together with the tanks under a pressure indicated in the record of compartments, tanks, manholes and hatches.

N o t e s: 1. Test pressures for the pipe lines are indicated in the diagram (See Appendix 1).
2. When supplying pressure through valve 9, be careful lest the pressure should rise above the specified value.
3. When testing the tanks, see to it that the sounding rods on the tanks are removed.

CAUTION! Safety valves 13 - 18 and pressure gauges 27 and 28 whose working pressure is below the test pressure shall be removed and the pipe unions shall be blanked off during test.

T a b l e 2

No.	Pipe line section	Valves in SHUT position	Valves in OPEN position	Point to be connected to hydraulic ram
1	Fore portion of air pipe line	5, 6	19, 20[x]	
2	Aft portion of air pipe line	7, 8	19, 20[xx]	
3	Water pipe line of port tanks	2, 4, 12	22	Pipe unions for drain plugs
4	Water pipe line of starboard tanks	1, 3, 12	21	

x) The handles of control valves 19, 20 are set to the AIR TO BOW - VENTING OF STERN position.

xx) The handles of control valves 19, 20 are set to the AIR TO STERN - VENTING OF BOW position.

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APPENDICES

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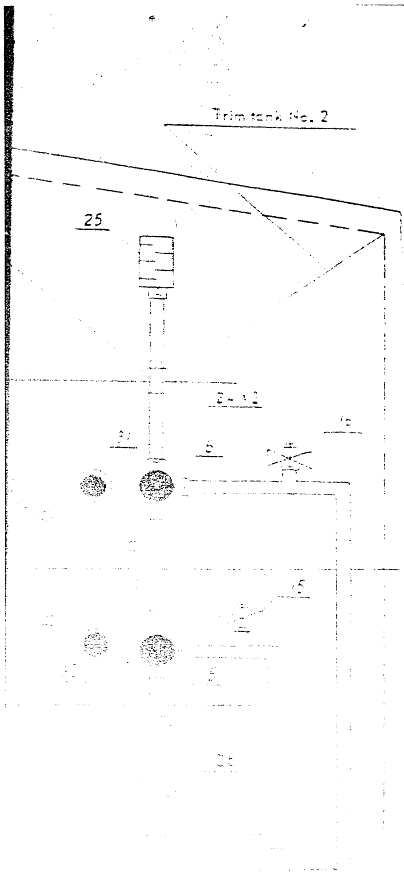

TRIM SYSTEM SCHEMATIC DIAGRAM

Refs	Description	Symbols
1, 2, 3, 4, 5, 6, 7, 8	Shut-off valve sealed in OPEN position	
21, 22, 9	Shut-off valve	
10, 11	Pressure-reducing valve	
12	Two-valve manifold with shut-off valves	
13, 14, 15, 16, 17, 18	Safety valve	
[illegible]	Control valve	
[illegible]	Pressure gauge	
[illegible]	[illegible] flowmeter	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
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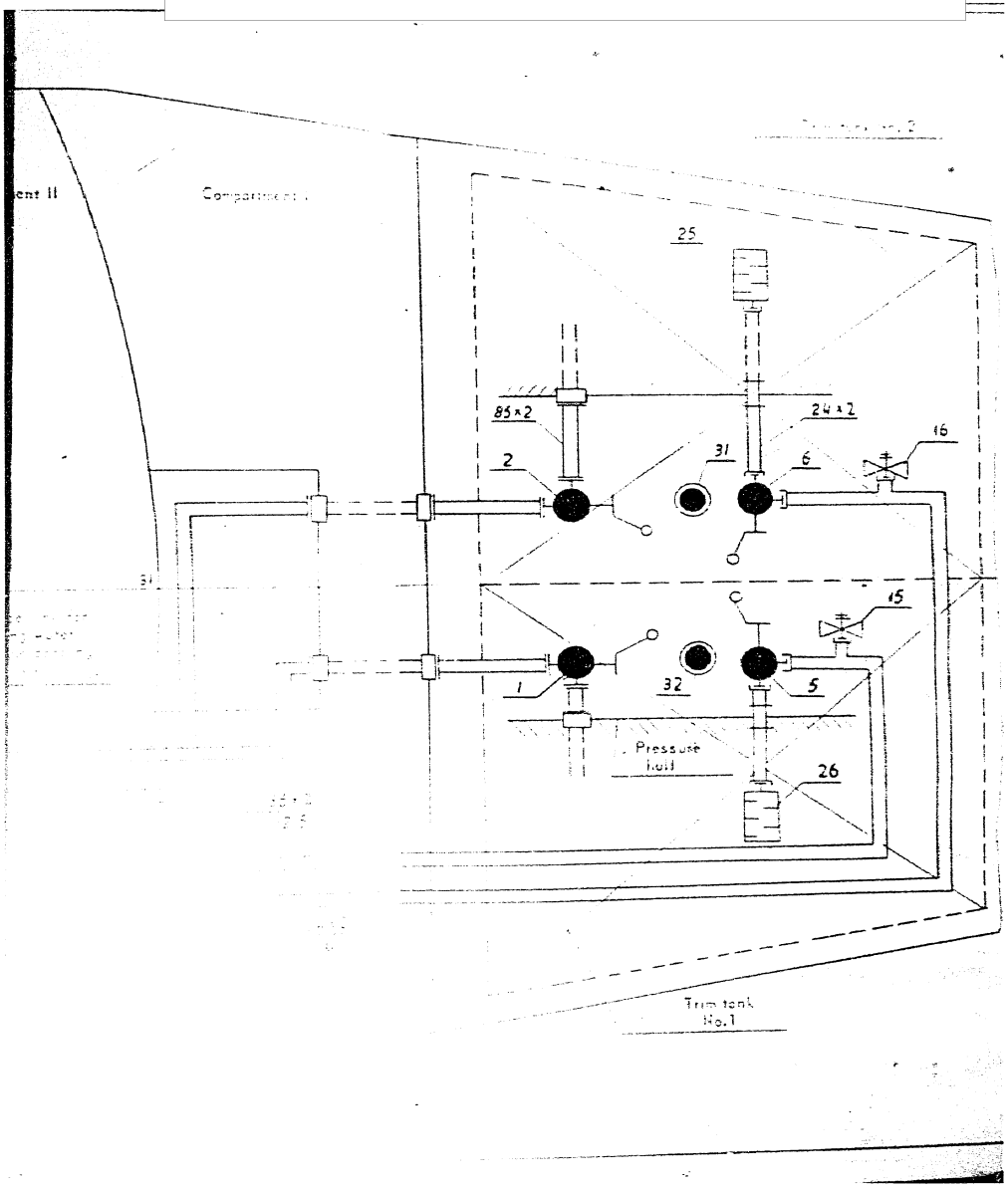

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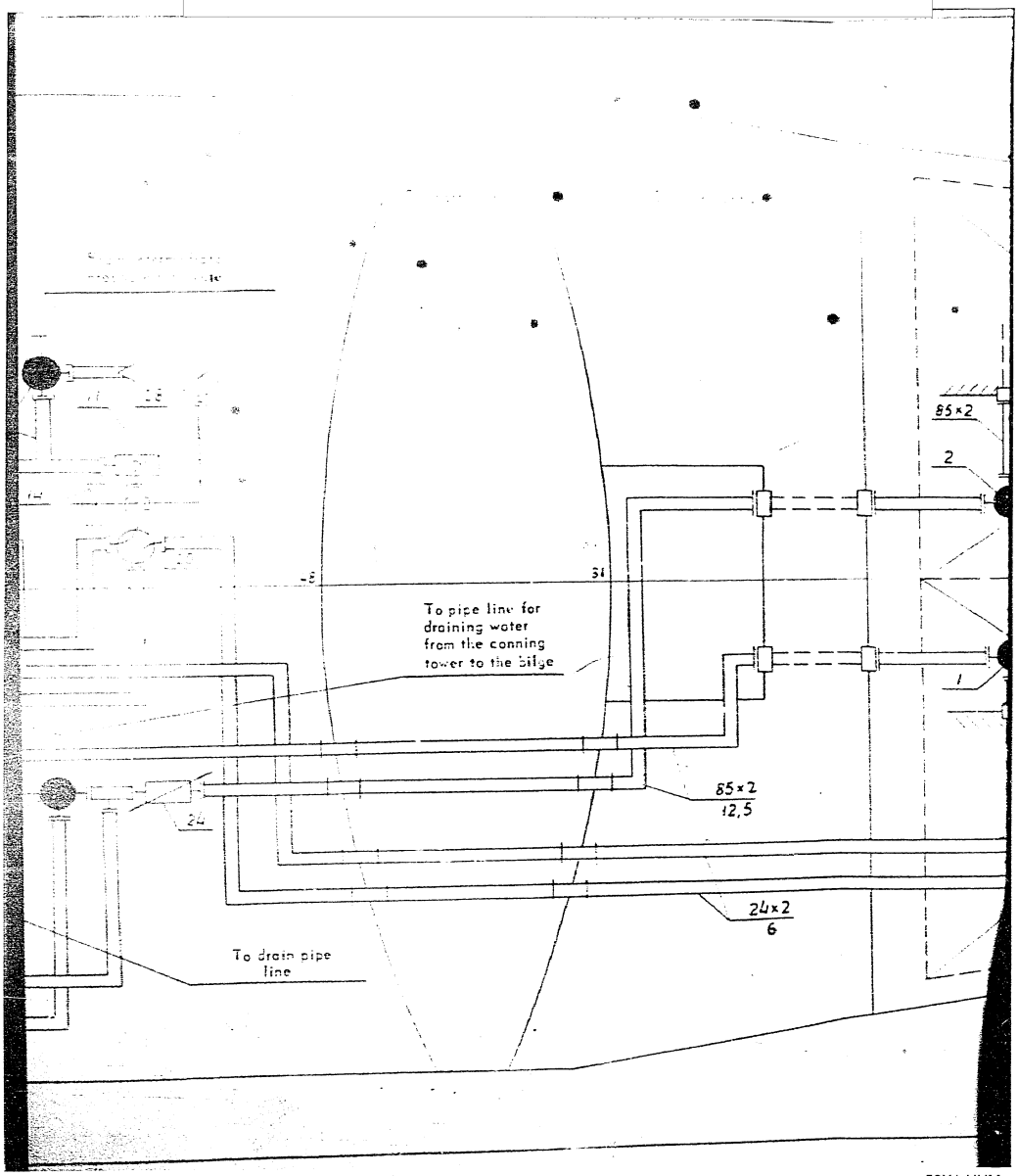

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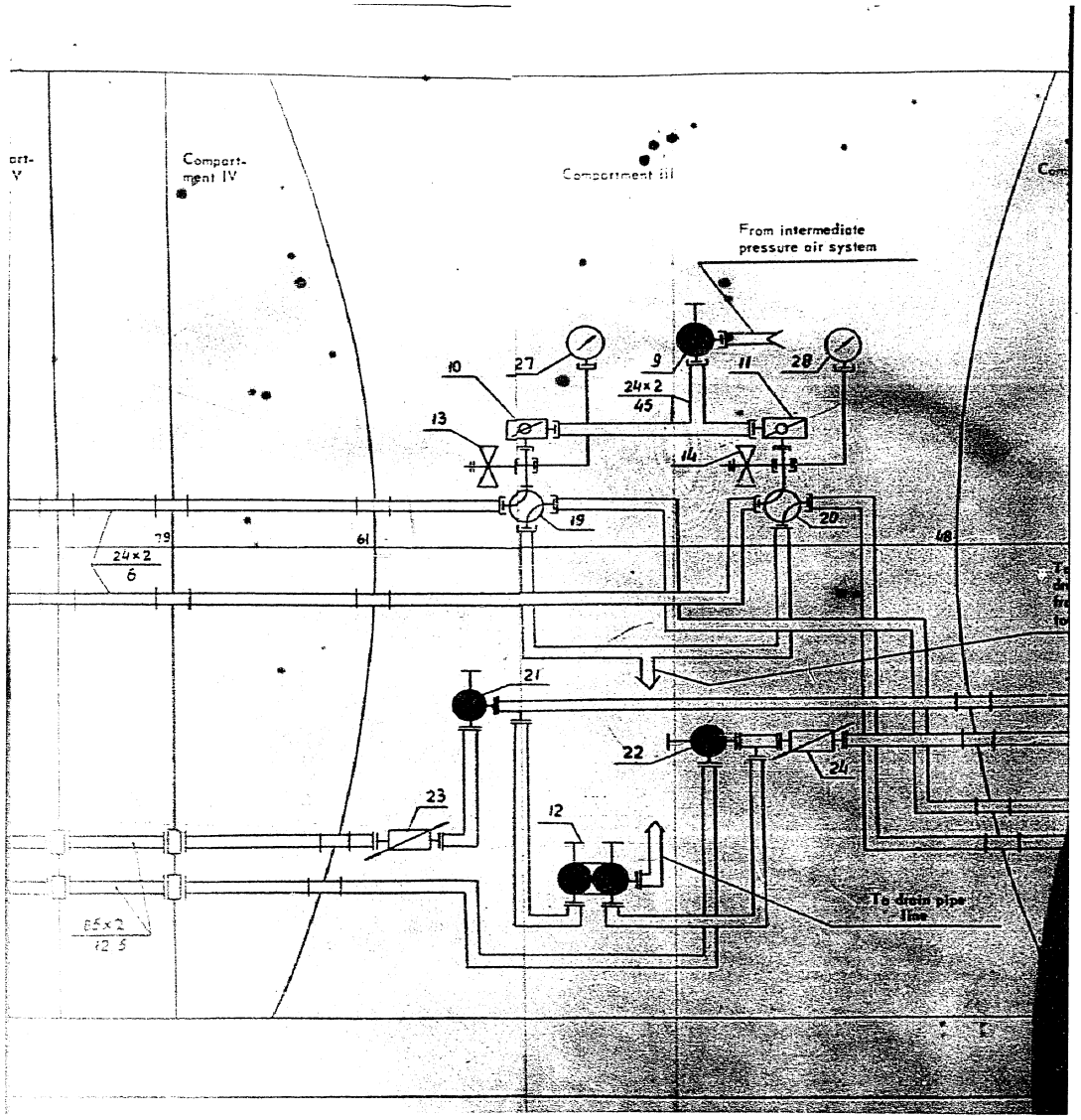

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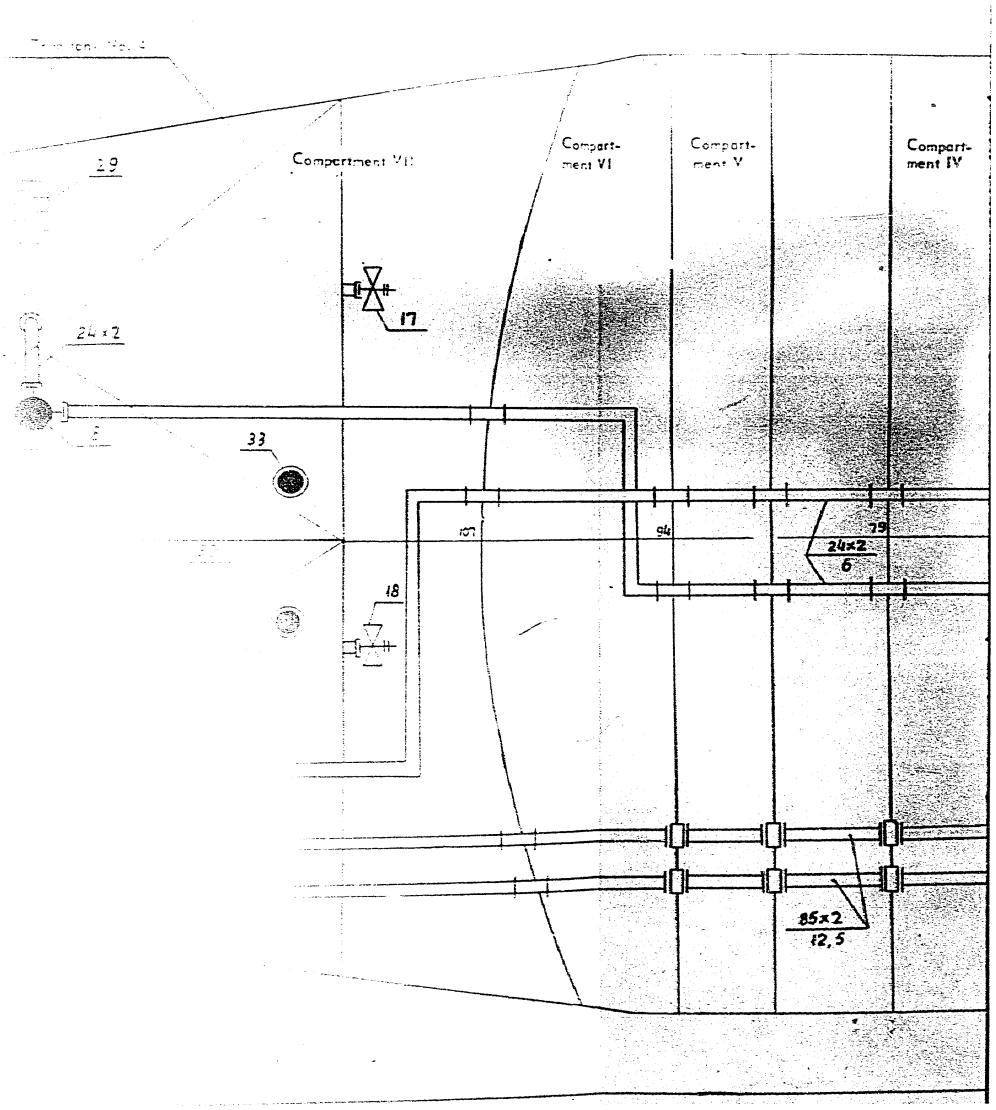

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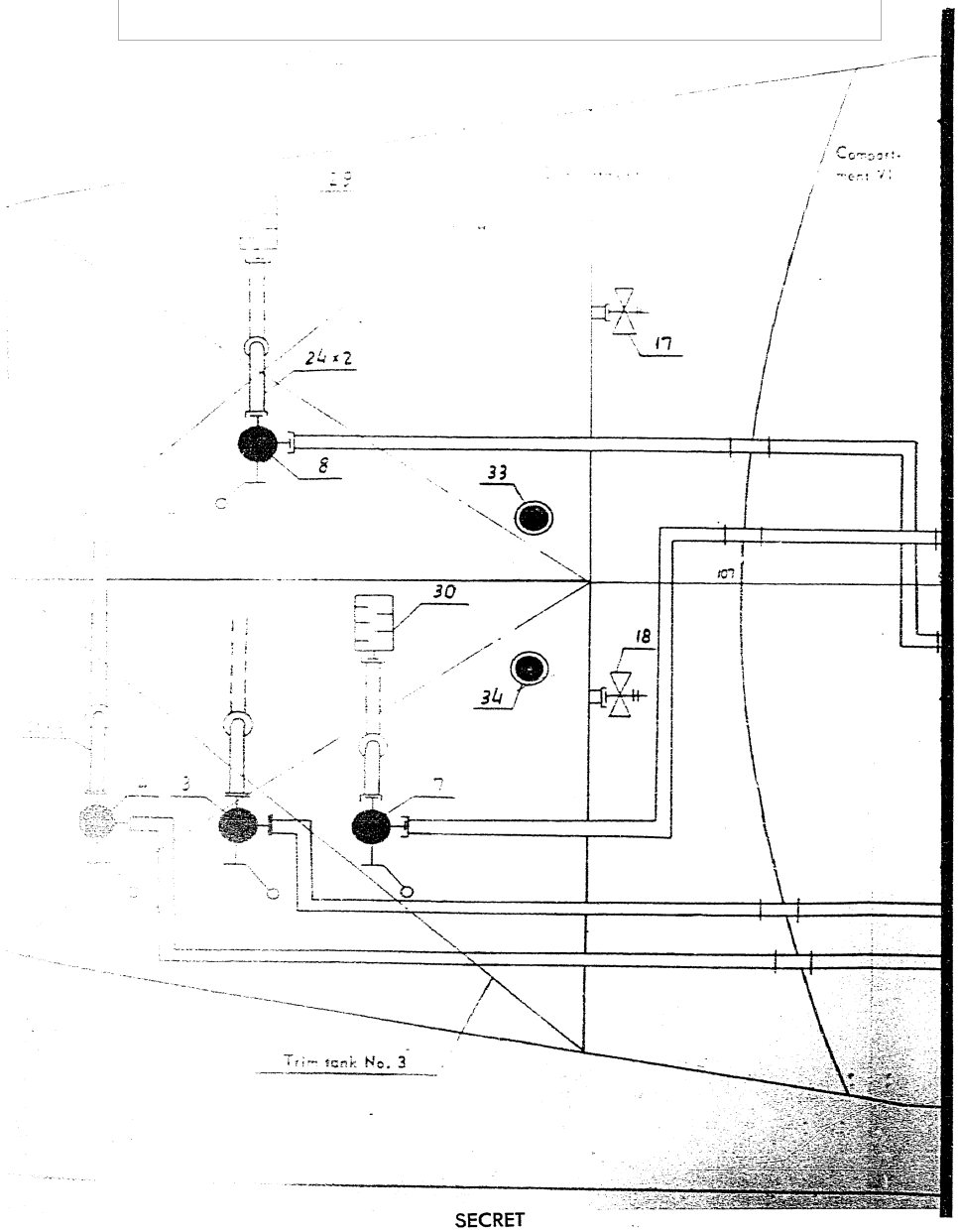

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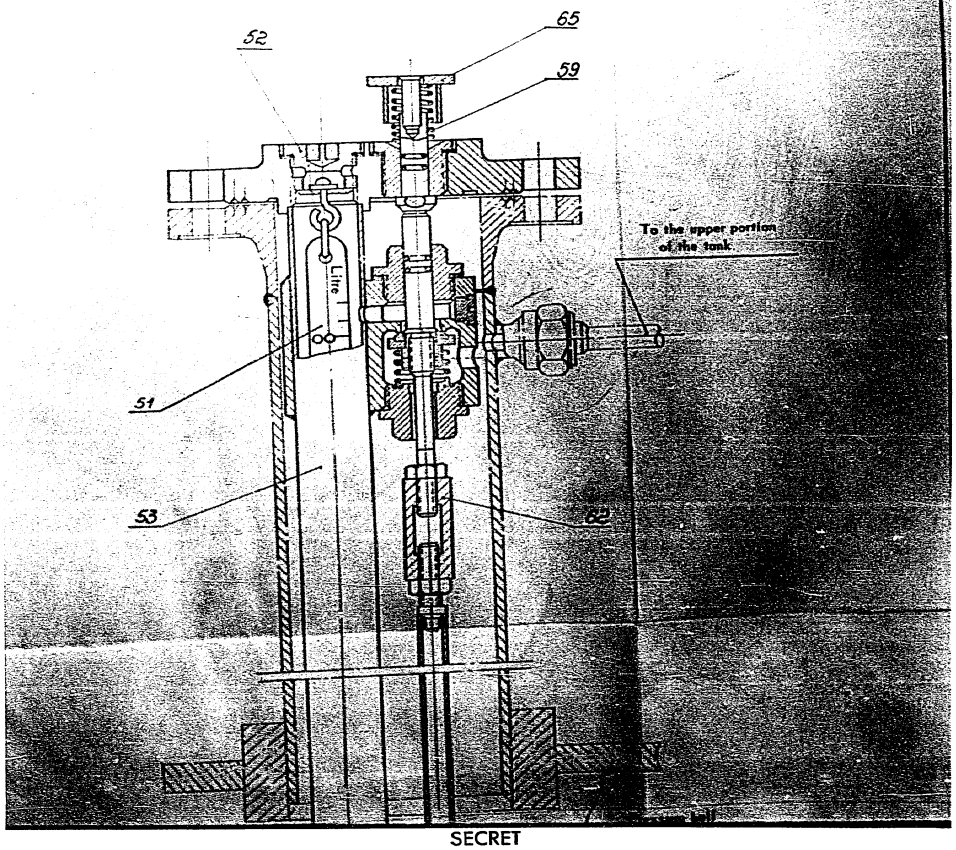
Appendix 2



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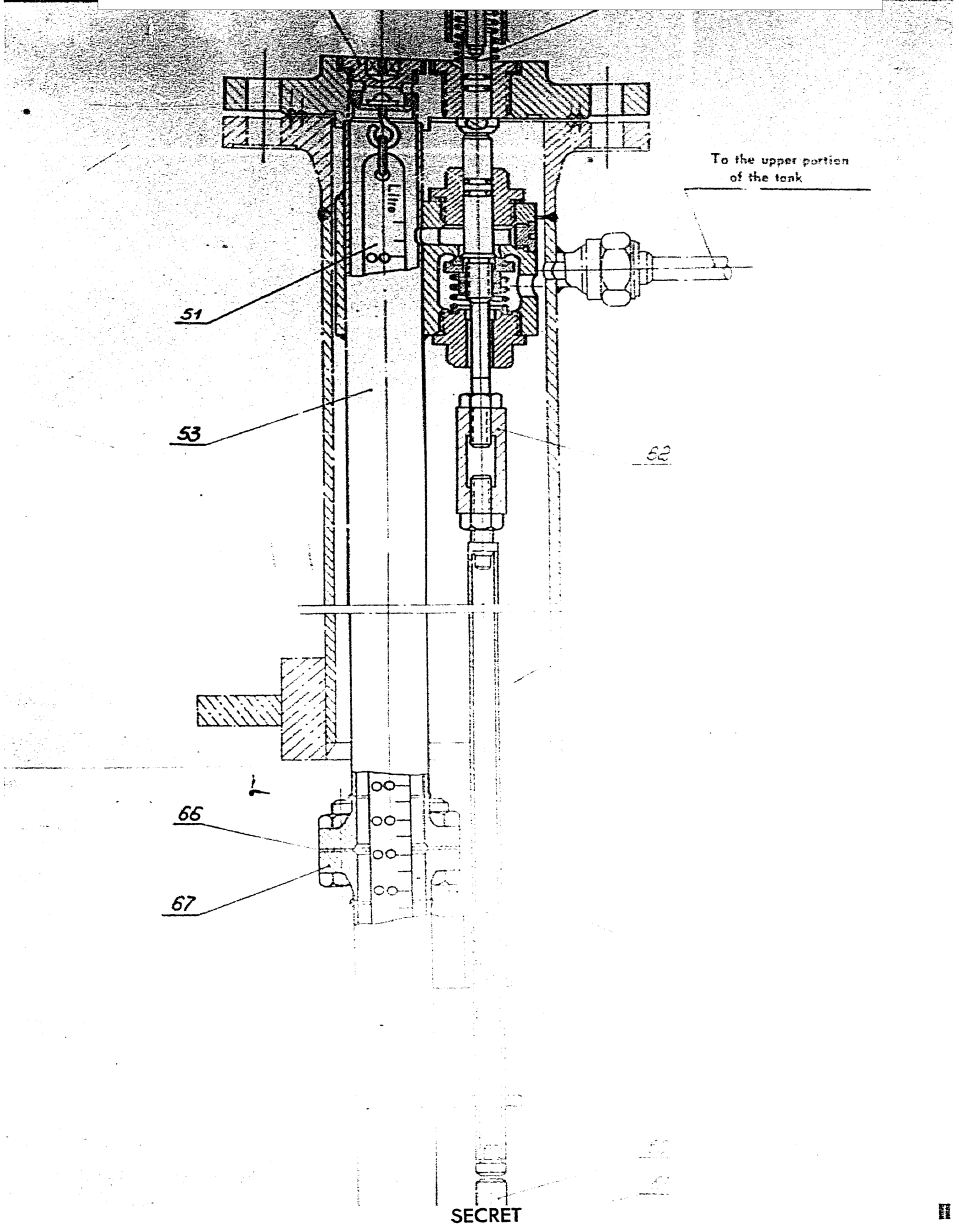

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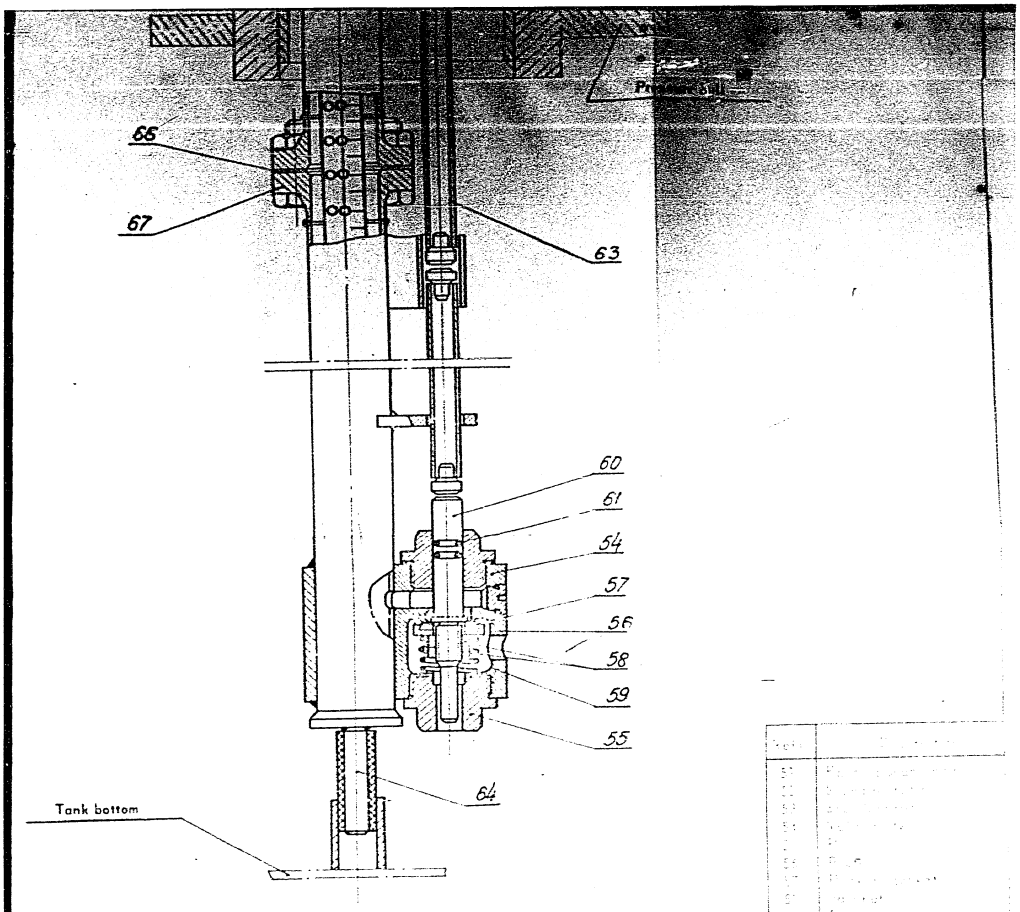


SPLIT SOUNDING ROD FOR FORE TANKS

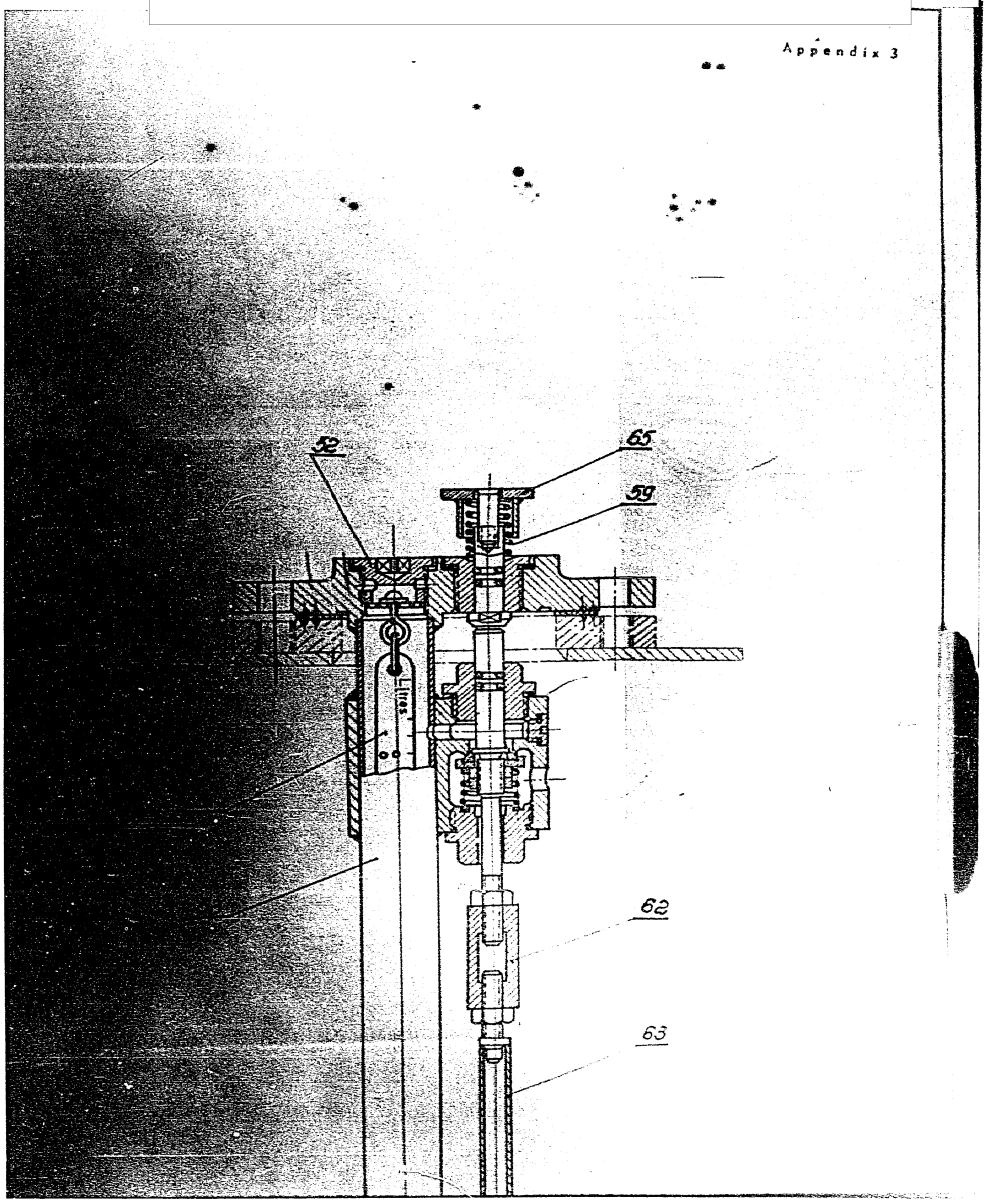
Item	
59	Spring
60	Stem
61	Packing ring
62	Coupling
63	Tapper
64	Socket pin
65	Bolt
66	Gasket
67	Flange

50X1-HUM

SECRET

50X1-HUM

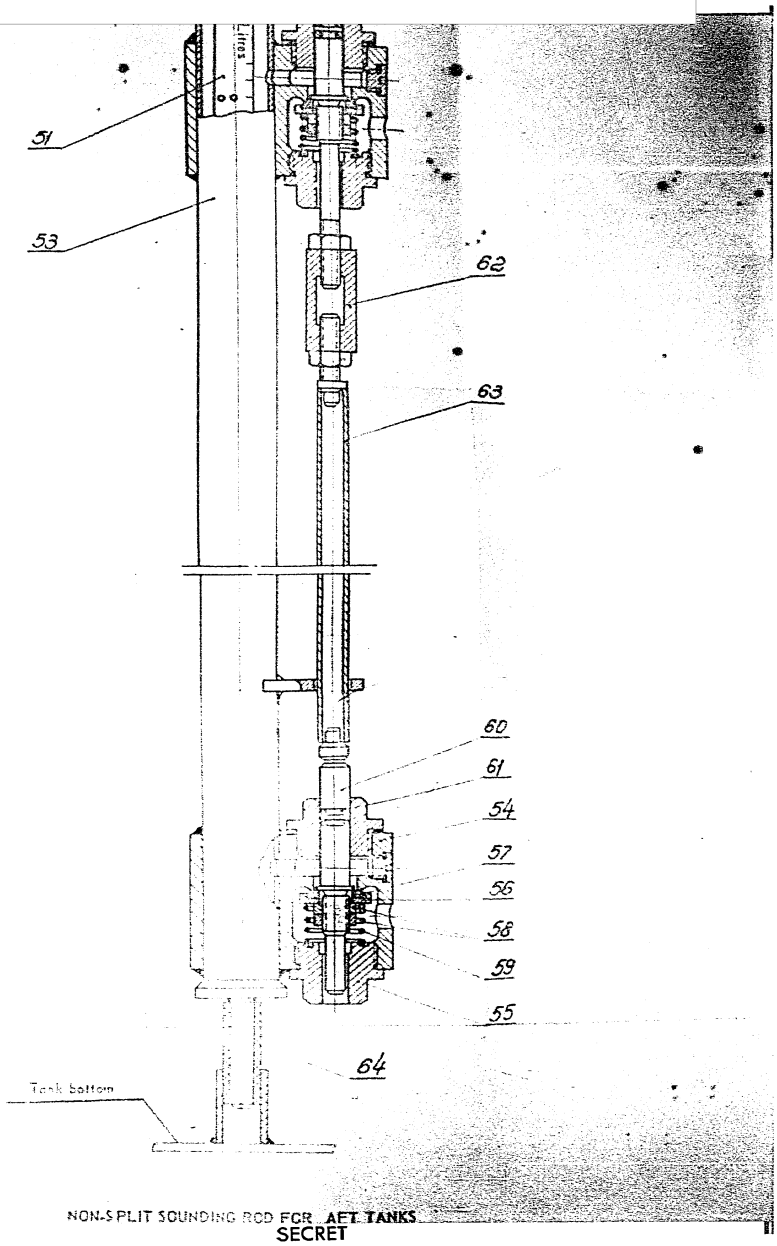
Appendix 3



50X1-HUM

SECRET

50X1-HUM



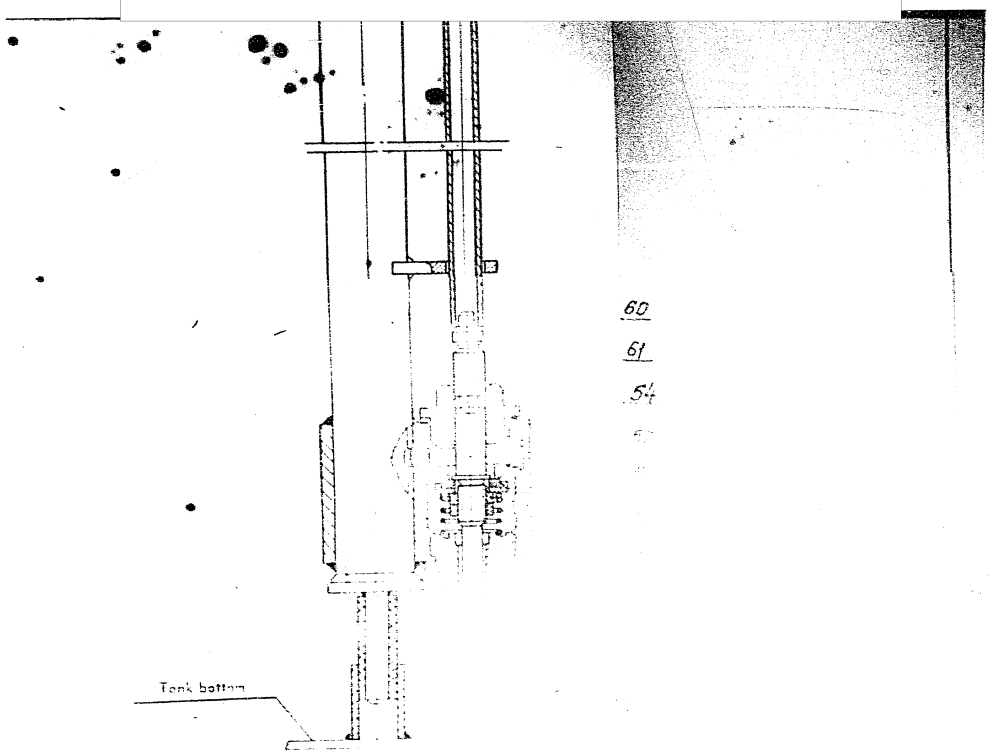
NON-SPLIT SOUNDING ROD FOR AFT TANKS

SECRET

50X1-HUM

SECRET

50X1-HUM



NON-SPLIT SOUNDING ROD

SECRET

50X1-HUM

50X1-HUM